Licensing Small Hydropower
and Conserving
Fish and Other Aquatic Life

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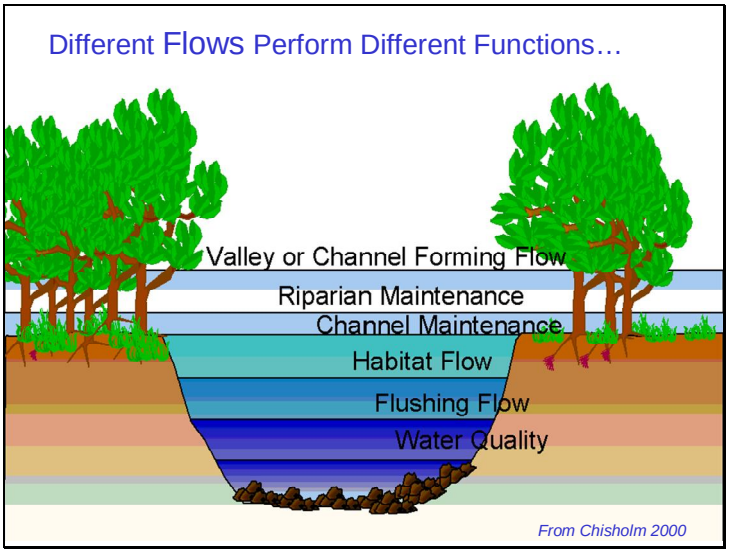
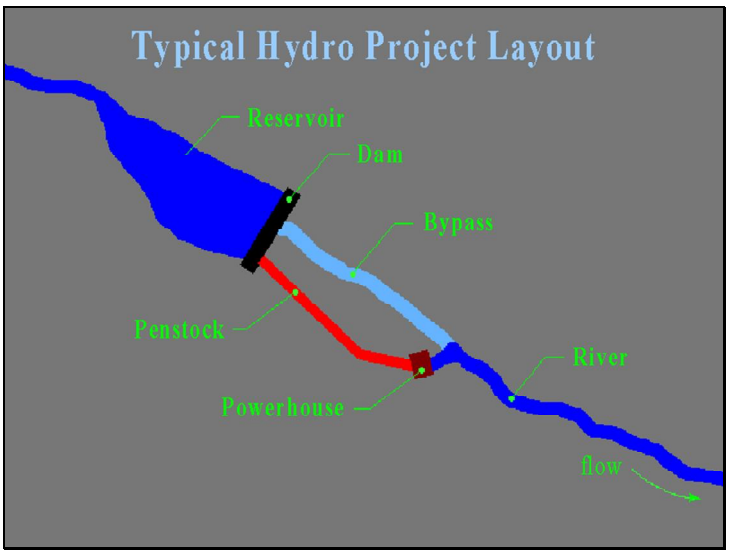
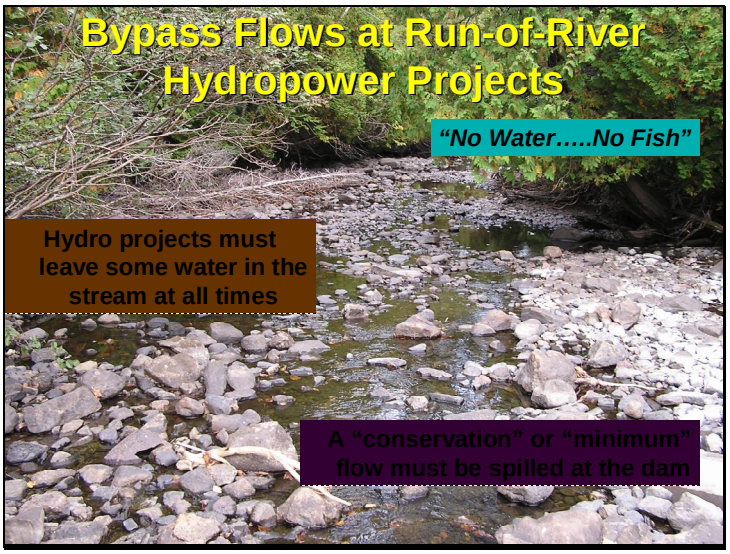


Healthy rivers need inter-annual and intra-annual flow variability -- a complicated topic beyond the scope of this workshop. This presentation focuses solely on flows for hydro bypasses at run-of-river projects to be developed at existing dams.



The segment of river between the dam and where flows from the powerhouse return to the river is called the bypass. In Vermont, bypasses are as long as 3.5 miles. At the other end of the spectrum, some projects have the powerhouse located at the base of the dam and there is no bypass. Water spilled at the dam and passed through a bypass cannot be used for generation.

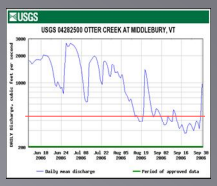


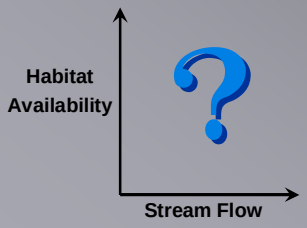
A retired biologist used to say "no water, no fish" as the bottom-line explanation of the need for instream flows. While this may be obvious, determining how much water is enough to protect fisheries resources is not. Bypass flow requirements often specify a single flow that must be passed through the bypass at all times. Sometimes seasonal flows to protect spawning are also required.

Agency Procedure for Determining Acceptable Minimum Stream Flows

Based on the US Fish & Wildlife Service New England Flow Policy

Flow Standards based on seasonal median flows -- New England Aquatic Base Flow (ABF) Method





Alternatively, applicants may do site specific studies

The Agency Procedure for Determining Acceptable Minimum Stream Flows describes how ANR will determine minimum instream flow requirements. It can be found at http://www.anr.state.vt.us/dec/fed/damsafety/docs/flowprocedure.pdf

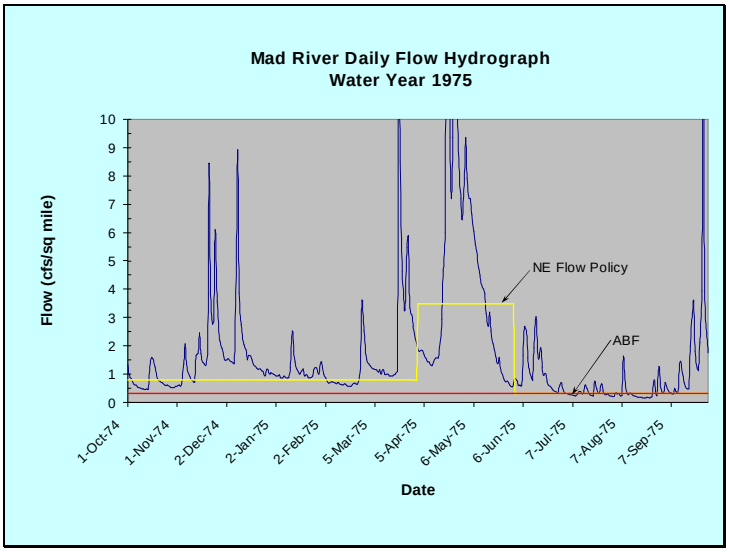
Applicants can use conservation flows based on river hydrology or they can do site-specific studies.

New England Aquatic Base Flow (ABF) Method

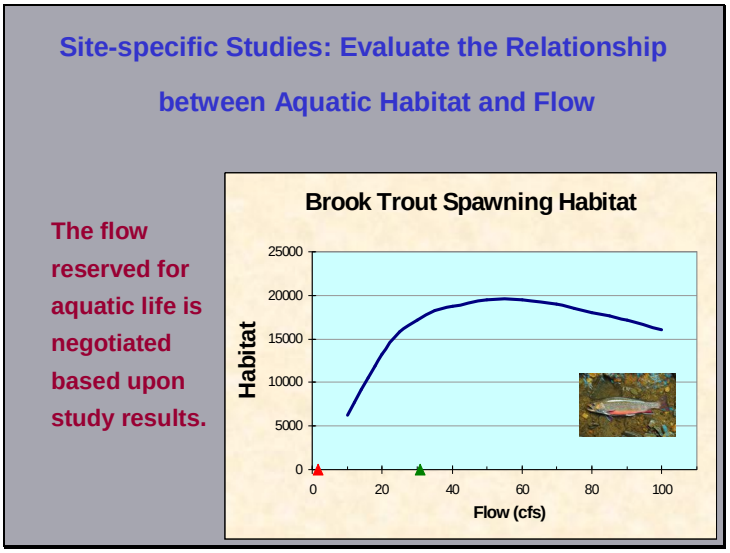
- **Recommends the August median flow and where applicable, seasonal median flows for spawning and incubation**
- **For rivers lacking adequate gage data, "default" regional average values are used**

Season	Period	Median Flow Standard	Default (cfs/mi^2)
Fall/winter	Oct 1 - Mar 31	February	1.0
Spring	Apr 1 - May 31	April/May	4.0
Summer	Jun 1 - Sep 30	August	0.5

The ABF method is an office-based technique that uses hydrologic statistics as surrogates for aquatic habitat. It assumes: 1) Aquatic life has evolved to survive "typical" summer low flows, and 2) Historical median flows during spawning and incubation periods will protect reproduction.



This graph shows the flow in the Mad River for an average (neither dry nor wet) water year. The red line shows the three seasonal flows described in the Agency Flow Procedure and New England Flow Policy.

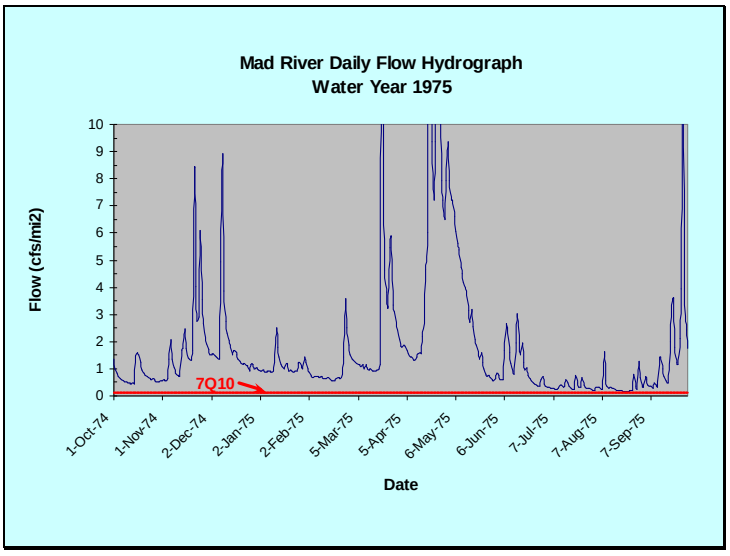


Site-specific studies typically measure habitat conditions (such as depth, velocity, substrate, cover) and determine how these conditions change at different flows. Hydropower developers sometimes elect to conduct these studies as the results sometimes support a flow lower than those in the Agency Flow Procedure.

7Q10

- The lowest flow that occurs for 7 consecutive days, on average every 10 years
- Used as a worst-case drought flow for design of wastewater treatment plants
- As a flow standard:
  - No biological basis
  - Will not protect aquatic life; severe degradation is likely

The 7Q10 refers to the lowest average streamflow expected to occur for seven consecutive days with an average frequency of once in ten years. The 7Q10 is a flow statistic used to simulate drought conditions in water quality modeling to evaluate waste load allocation. If used as a long-term minimum requirement, this flow can be expected to result in severe degradation of aquatic communities.



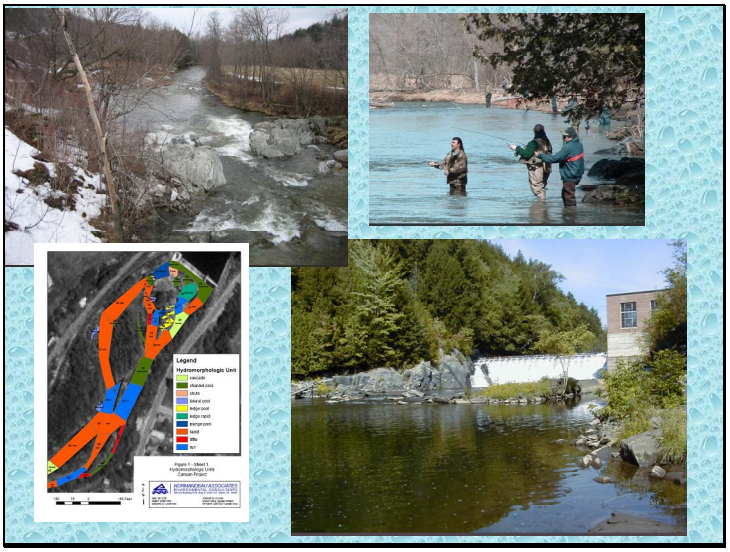
Fish communities can generally withstand near-drought conditions that occur infrequently and for short periods. However, setting such a flow as a long-term condition will not sustain them.

This photograph shows the Mad River in Moretown, Vermont at flow of 7Q10. Much of the stream bottom is dewatered. There is very little water movement. Fish are crowded into pools and vulnerable to predation. Fish will have difficulty migrating upstream. Aquatic life can generally survive such conditions in the short term.

The Fish and Wildlife Department provides advice on:

- What to do next
- Studies or information needed; study design and scope
- Information on the fisheries resources

The Vermont Department of Fish and Wildlife is an active participant in the hydropower licensing process because of the potential effects on fish habitat. The Department can provide advice about which fisheries and aquatic resource issues apply at a specific site, what the instream flow needs are, and what studies may be needed to address these issues. Information about local fisheries resources is generally available.



Hydropower is an important part of the nation's energy mix, although these projects also have adverse effects on ecosystems and aquatic resources. Hydropower projects should be environmentally sound and not endanger the long-term environmental health of Vermont's rivers.